

## **REMARKS**

The Office Action dated May 2, 2005, has been received and carefully noted. The amendments made herein and the following remarks are submitted as a full and complete response thereto.

Claims 1 and 5 have been amended. The Abstract of the Disclosure has also been amended. Applicants submit that the amendments made herein are fully supported in the specification and the drawings as originally filed, and therefore no new matter has been added. Accordingly, claims 1-6 are pending in the present application and are respectfully submitted for consideration.

### **Specification**

The Abstract was objected to. The Abstract has been amended to be within the range of 50 to 150 words, and therefore is in compliance with US patent practice.

### **Claims 1, 3 and 5 Rejected under 35 U.S.C. §102(b)**

Claims 1, 3 and 5 were rejected under 35 U.S.C. §102(b) as being anticipated by Hu (U.S. Patent No. 5,725,739). This rejection is respectfully traversed.

Claim 1, as amended, recites a bias sputtering film forming process for forming a thin film by applying both voltages of a cathode voltage and a substrate bias voltage, wherein a thin film is formed on a substrate whereon an irregularity is formed in the state wherein only the cathode voltage out of said both voltages is applied, and sputtering film forming is performed while continuously varying said substrate bias voltage so that the thickness of said thin film formed on the surfaces on the sidewalls and on the bottoms of said irregularity is substantially uniform.

Claim 5, as amended, recites a bias sputtering film forming apparatus comprising an AC power source or a DC power source of variable output against substrate electrodes and a control system, wherein said control system makes the cathode voltage set to a predetermined voltage previously, stores the substrate bias voltage value when the substrate is apart from the target by a predetermined distance and the thickness distribution of thin films on each of said surfaces corresponding to said substrate bias voltage value as reference data, and controls the output of said power source such that it is continuously varied based on bias voltage functions produced by selecting the substrate bias voltage value that makes said film thickness substantially uniform from said reference data when each of said surfaces is formed.

It is respectfully submitted that the prior art fails to disclose or suggest at least the above-mentioned features of the Applicants' invention.

In particular, Applicants submit that the claimed invention relates to a bias sputtering film forming process and a bias sputtering film forming apparatus for example, wherein a uniform thin film is formed on the internal wall surface of the substrate whereon an irregularity is formed, such as a contact hall, a wiring groove and the like of a high aspect ratio.

For instance, sputtering is used in order to form a thin film for a barrier layer and a seed layer, prior to meal plating and the like, on the irregularity of a contact hall, a wiring groove and the like which are formed on a substrate surface.

In one embodiment of the present invention for example, a thin film is formed on the surfaces on the sidewalls and on the bottom of the irregularity, first by performing

sputtering in the state wherein only a cathode voltage is applied, and then, by performing it either in the state wherein a substrate bias voltage is applied or in the state wherein both the substrate bias voltage and the cathode voltage are applied. Accordingly, at least one of the significant features of the claimed invention resides in that the substrate bias voltage in the second phase sputtering is controlled to be continuously varied so that a uniform thin film is formed on the surface of the irregularity of the substrate, as recited in claim 1.

Furthermore, Applicants submit one exemplary reason why sputtering is performed in the state wherein only a cathode voltage is applied in the first phase. For instance, when the sputtering is performed from the beginning in the strong state wherein the bias voltage is applied to the substrate, damage, deterioration and the like could occur on the substrate. In order to avoid these circumstances, a preliminary thin film is formed in the weak state wherein only a cathode voltage is applied to the target so that damage is prevented from occurring on the substrate due to the preliminary thin film in the second phase sputtering, for example.

In contrast, Hu merely discloses a process of forming a thin film on a substrate, wherein a DC bias is applied to a target, and no bias is applied to a substrate in the first phase sputtering to deposit an overhang portion at the top of the irregularity of the substrate (see col. 6, lines 10-37). Thereafter, the sputtering of Hu is performed while the bias is applied to the substrate (resputter scheme, see col. 6, lines 38-55).

Furthermore, Hu provides that, in the first phase, the overhang material 150 is deposited at the top corner 118 (on the upper surface) of the contact hole by sputtering

while only a cathode voltage is applied. At the second phase, the overhang material 150 at the top corner 118 is redistributed to the bottom 116 of the contact hole (at the lower surface), whereby the thickness of the thin film at the bottom 116 becomes sufficient (see col. 6, lines 38-55).

Consequently, Hu is totally different from the inventions recited in claims 1 and 5 of the present application. In the presently claimed invention, the first phase sputtering by applying only a cathode voltage is performed, not for depositing an overhang in the top of the irregularity on the substrate, but for forming a preliminary thin film for protecting the substrate from the second phase sputtering. The second phase sputtering is performed not for redistributing an overhang material to the bottom of the irregularity, but for depositing sputtering material on the sidewalls and bottom of the irregularity, which are formed in the first phase sputtering so as to form a thin film on the sidewalls and bottom of the irregularity, i.e., on the surface of the irregularity. Furthermore, the present invention provides that a uniform thin film is obtained by continuously varying the substrate bias voltage applied in the second phase sputtering.

Therefore, it is respectfully submitted that the cited prior art fails to disclose or suggest each and every limitation recited in claims 1 and 5 of the present application.

Moreover, to qualify as prior art under 35 U.S.C. §102, a single prior art reference must teach, i.e., identically describe, each feature of a rejected claim. As explained above, Hu fails to disclose or suggest each and every feature of claims 1 and 5. Accordingly, Applicants respectfully submit that claims 1 and 5 are not anticipated by Hu. Therefore, Applicants respectfully submit that claims 1 and 5 are allowable.

As claim 3 depends from claim 1, Applicants submit that claim 3 incorporates the patentable aspects therein, and is therefore allowable for at least the reasons set forth above with respect to the independent claims, as well as for the additional subject matter recited therein.

Accordingly, Applicants respectfully request withdrawal of the rejection.

**Claims 1-3, 5 and 6 Rejected under 35 U.S.C. § 102(b)**

Claims 1-3, 5 and 6 were rejected under 35 U.S.C. § 102(b) as being anticipated by Gopalraja et al. (U.S. Patent No. 6,193,855 B1, hereinafter "Gopalraja"). This rejection is respectfully traversed.

Gopalraja merely discloses a process wherein a DC bias is applied to the target and simultaneously a DC bias is applied to the substrate (see col. 5, lines 2-6). The sputtering involves filling the irregularity of the substrate (see Figs. 1 and 2). There are two phases to the sputtering of Gopalraja. In the first phase, the bias is applied to the target and no bias is applied to the substrate (see col. 7, lines 34-42). In the second phase, the target bias is terminated (see col. 8, lines 24-26) and a variable bias is applied to the substrate (see Fig. 6). As can be seen from Figs. 5 and 6 of Gopalraja, the bias to the substrate and target is varied.

However, Applicants submit that the bias applied to the substrate as shown in Figs. 5 and 6 of Gopalraja is varied discontinuously as a pulse.

Accordingly, it is submitted that Gopalraja does not disclose or suggest at least the feature of the present invention in that the substrate bias applied in the second phase sputtering is continuously varied so that the thin film is formed uniformly not only

on the surface on the bottom but also on the surface on the sidewalls of the irregularity of the substrate.

Therefore, Applicants submit that Gopalraja fails to disclose each and every element recited in claims 1 and 5 of the present application.

As mentioned above, to qualify as prior art under 35 U.S.C. §102, a single prior art reference must teach, i.e., identically describe, each feature of a rejected claim. Gopalraja fails to disclose or suggest each and every feature of claims 1 and 5. Accordingly, Applicants respectfully submit that claims 1 and 5 are not anticipated by Gopalraja. Therefore, Applicants respectfully submit that claims 1 and 5 are allowable.

As claims 2 and 3 depend from claim 1, and claim 6 depends from claim 5, Applicants submit that each of claims 2, 3 and 6 incorporates the patentable aspects therein, respectively, and are therefore allowable for at least the reasons set forth above with respect to the independent claims, as well as for the additional subject matter recited therein.

Accordingly, Applicants respectfully request withdrawal of the rejection.

**Claim 4 Rejected under 35 U.S.C. § 103(a)**

Claim 4 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Gopalraja in view of Yamamoto (U.S. Patent Publication No. 2002/0173144 A1). In addition, claim 4 was also rejected under 35 U.S.C. § 103(a) as being unpatentable over Hu in view of Yamamoto. This rejection is respectfully traversed.

Gopalraja and Hu are discussed above.

Yamamoto is applied for allegedly showing “a copper seed layer.” Yamamoto does not overcome the above-described drawbacks of Gopalraja or Hu.

To establish *prima facie* obviousness, each feature of a rejected claim must be taught or suggested by the applied art of record. See M.P.E.P. §2143.03 and In re Royka, 490 F.2d 981 (CCPA 1974). As explained above, Hu in view of Yamamoto or Gopalraja in view of Yamamoto, do not teach or suggest each feature recited in claim 4. Accordingly, for the above provided reasons, Applicants respectfully submit that claim 4 is not rendered obvious under 35 U.S.C. § 103 by the teachings of Hu in view of Yamamoto or Gopalraja in view of Yamamoto.

Furthermore, Applicants respectfully note claim 4 depends from claim 1. Therefore, it is respectfully submitted that claim 4 should be deemed allowable for at least the same reasons claim 1 is allowable, as well as for the additional subject matter recited therein.

Under U.S. patent practice, the PTO has the burden under §103 to establish a *prima facie* case of obviousness. In re Fine, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988). Both the case law of the Federal Circuit and the PTO itself have made clear that where a modification must be made to the prior art to reject or invalidate a claim under §103, there must be a showing of proper motivation to do so. The mere fact that a prior art reference could arguably be modified to meet the claim is insufficient to establish obviousness. The PTO can satisfy this burden only by showing some objective teaching in the prior art or that knowledge generally available to one of ordinary skill in the art would lead that individual to combine the relevant teachings of the references.



Id. In order to establish obviousness, there must be a suggestion or motivation in the reference to do so. See also In re Gordon, 221 USPQ 1125, 1127 (Fed. Cir. 1984) (prior art could not be turned upside down without motivation to do so); In re Rouffet, 149 F.3d 1350 (Fed. Cir. 1998); In re Dembiczak, 175 F.3d 994 (Fed. Cir. 1999); In re Lee, 277 F.3d 1338 (Fed. Cir. 2002). The Office Action restates the advantages of the present invention to justify the combination of references. There is, however, nothing in the applied references to evidence the desirability of these advantages in the disclosed structure.

Applicants respectfully request withdrawal of the rejection.

### **Conclusion**

In view of the above, Applicants respectfully submit that each of claims 1-6 recites subject matter that is neither disclosed nor suggested in the cited prior art. Applicants also submit that the subject matter is more than sufficient to render the claims non-obvious to a person of ordinary skill in the art, and therefore respectfully request that claims 1-6 be found allowable and that this application be passed to issue.

If for any reason, the Examiner determines that the application is not now in condition for allowance, it is respectfully requested that the Examiner contact the Applicants' undersigned attorney at the indicated telephone number to arrange for an interview to expedite the disposition of this application.

In the event this paper has not been timely filed, the Applicant respectfully petitions for an appropriate extension of time. Any fees for such an extension, together with any additional fees that may be due with respect to this paper, may be charged to



counsel's Deposit Account No. 01-2300, referring to client-matter number 101136-00095.

Respectfully submitted,



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Enclosure: Petition for Extension of Time (one month)